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Design & Estimation of Solar Based ATM Counter

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***Abstract*—** This paper demonstrates a theoretical cost calculation for a particular Automated Teller Machine (ATM) counter which will operate through solar energy. Basically the paper is deal with two situations. First we represent the monthly cost when the ATM counter is not operate through solar energy and the next situation is that we calculate the cost when it is operate through solar energy. In this paper, we are going to discuss how we can reduce the cost for the particular ATM counter through solar energy. At last, we show the payback time for the operation process through solar energy. This will be a good option for the future and the overall result will provide an efficient system.

***Keywords*—** Solar Energy, Solar Panel, Battery, Payback Periods

I. INTRODUCTION

At present situation, energy demand is one of the major issues in the world, especially; in India due to more population the energy demand is become a serious problem. So we need to move forward towards non-conventional energy sources like solar, wind, tides etc. Automated teller machine (ATM) is an electronic machine which is basically used for banking purpose. The significant growth of solar energy in the world as well as in India should be implemented in a larger way.

This paper starts with the basic monthly cost calculation for a particular ATM counter operating without solar energy. After that we demonstrate a calculation cost for the solar installation process for same ATM counter. Solar panel and battery is added in the solar installation process and also charge controller is used to protect the battery from over-charging. We also use surge protection device (SPD), inverter, and DC wire in the installation process. This implementation through solar energy will helps to reduce the monthly cost for a particular ATM counter. The main advantage is that we will get the same service without paying more money [1, 2, 4, 5, 7].
Main objective of this work is to reduce the energy consumption from conventional sources.

II. PROPOSED SCHEME

A: Existing Load Study:
We have taken the general loads which are basically present in an ATM counter. We considered one ATM machine of 420 watt, two LED lights of 18 watt, one air conditioner of 1500 watt and one CCTV camera of 40 watt as the loads and it runs without solar energy. We calculate the monthly cost for the present situation. Next, in the proposed scheme also we have taken the existing loads that are present in an ATM counter and we will operate the ATM counter through solar energy and we calculate the installation cost for the process. Finally, we represents the payback period with respect to the both condition.

B: Calculation of Monthly Energy Consumption:

Table 1. Existing load with monthly uses

Sl. No.	*Item*	*Qty.*	*Total Power Ratting (kW)*	*Monthly Uses (Hrs.)*
1	ATM Machine	1	0.420	720
2	Light (LED)	2	0.036	720
3	Air Condition	1	1.500	720
4	CCTV	1	0.040	720

Total energy consume in a month is,

$$Total\ Power\ Consumption\ (kW)\ x\ Monthly\ Uses\ (Hrs.)$$

Let assume per unit energy chare is Rs. 7.00. Then total electricity bill per month is,

$$Total\ Power\ Consumption\ (kW)\ x\ Monthly\ Uses\ (Hrs.)\ x\ Per\ unit\ Charge\ (Rs.)$$

That will be. Rs. 10, 070/- (Approx.)
Yearly electricity bill will be Rs. 1, 20,840 /- (Approx.)

III. DESIGN OF SOLAR PLANEL

Solar panels absorb sunlight as a source of energy to generate electricity. It is generally consists of a layer of silicon cells, a

metal frame, a glass casing and various wiring to allow current to flow from the silicon cells.

The load is same as used for the above calculation. We require the number of solar panel so we get this information from this calculation.

Table 2. Existing Watt-Hrs per day

Sl. No.	*Item*	*Qty.*	*Total Power Ratting (kW)*	*Watt-Hrs per day*
1	ATM Machine	1	0.420	10,080
2	Light (LED)	2	0.036	864
3	Air Condition	1	1.500	36,000
4	CCTV	1	0.040	960

As we will use inverter in the installation process, a Watt Loss will be occurred. Let assume watt loss per hrs. will be 12 watt.

So, Watt loss in one day is 288 watt.
So, total Watt-hour used per day will be 48,192 Watt-hour.
Let assume maximum voltage output form solar panel (loaded condition) will be 24 V (DC). So, Amp-Hrs used per day is,

$$\frac{\text{Watt} - \text{hour (Per Day)}}{\textit{Output Voltage}}$$

That will be 2008 Amp-Hrs.
Let assume some panel parameter for detailing the calculation of solar panel.

- Battery efficiency = 90%
- Charge-controller efficiency = 85%
- SPV directing factor = 1.2
- Availability of Sunlight = 4hrs. (peak hours)

So, current ratting of the solar panel will is,

$$\frac{\dfrac{\textit{Amp-Hour per Day}}{\textit{Battery Efficiency x Charge Controller Efficiency}} \textit{ x SPV Directing Factor}}{\textit{Peak Hour of Sunlight}}$$

That will be, 787.5 Amp.
According to to our desired capacity (48,192 Watt-Hrs & 2008 Amp-Hrs), we will considered 07 solar panels of 300 watt, 115 amp and the combination will be in parallel.

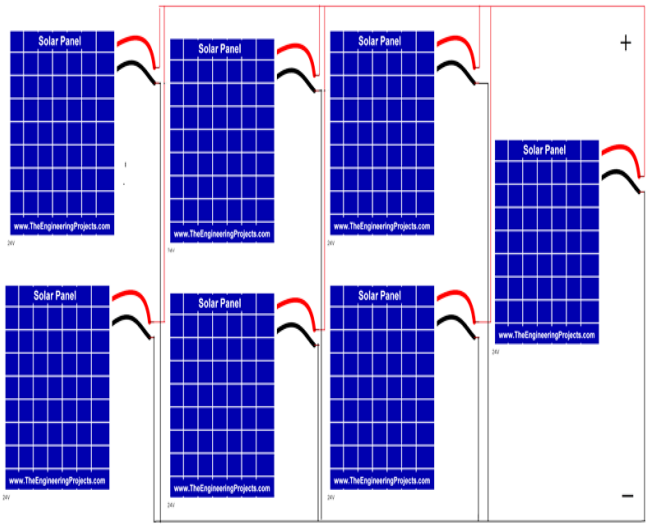

Figure 1. Design of Solar Panel

IV. CALCULATION OF BATTERY

The load is same as used for the above calculation. We require the number of battery we get this information from this calculation.
As per above calculation total Ampere-hour required per day will be 2008Ampere-hour. Let assume some Battery parameter for detailing the calculation.

- Depth of discharge = 0.8
- System design margin = 1.2
- Back-up =3 days (As per our design)

Then, total required battery generation is

$$\frac{\textit{Amp} - \textit{Hour per Day x Back up}}{\textit{Depth of Discharge}} \textit{ x System Design Margin}$$

That will be 9036 Ampere-hour.
According to our desired capacity (9036 Amp-Hrs), we will considered 10 battery of 24Volt, 1000Ampere-hour and the combination will be in parallel

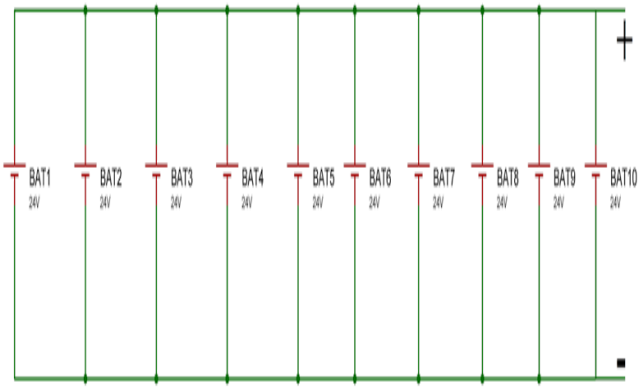

Figure 2. Design of Battery

V. DETAIL DESIGN CRITERIA

Main design equipment using solar is solar panel & battery, apart from this some other equipment is very necessary for detailing the design.

Charge Controller - It is basically prevents overcharging and may protect against over voltage, which can reduce battery performance. It may also prevent complete draining of a battery.

SPD - SPD means surge protection device, which basically protects the panels against the lighting surge.
Inverter – Convert DC to AC, in our project it is required 1 phase.

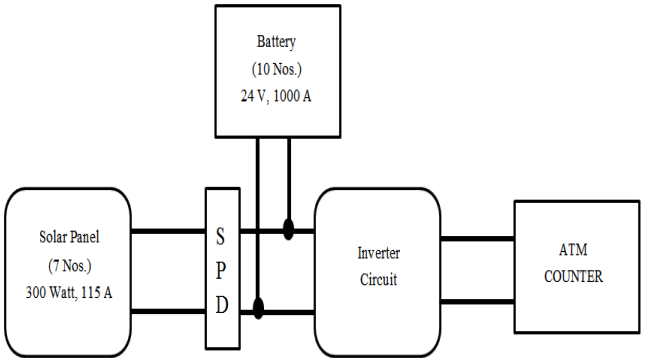

Figure 3. Block Diagram of the system

Table 3. List of required equipment with price (Approx.)

Sl. No.	*Item*	*Quantity*	*Price per Unit (Rs.)*	*Total Price (Rs)*
01	**Solar Panel**	**07**	**12,200**	**85,400**
02	**Battery**	**10**	**15,000**	**150,000**
03	**SPD / MOV**	**02**	**1,700**	**3,400**
04	**Charge-controller**	**01**	**600**	**600**
05	**Inverter**	**01**	**35,000**	**35,000**
06	**DC wire**			**5,000**
07	**Labour cost**			**20,000**

VI. PAYBACK CALCULATION

Now we need a big amount for the solar installation process, we need approximately an amount of rupees. 300,000
After solar installation per month saving is rupees 10,000
Then we will calculate the payback period if we install solar in an ATM. So, the time needed to recover the more cost for solar installation payback periods is

$$\frac{\text{Investment cost for solar installation}}{\text{Monthly savings}}$$

That will be approximately 30 months.

VII. CONCLUSION

The paper provides a brief cost calculation for both conditions, when the ATM counter is not operate through solar energy and when it will operate through solar energy. From the above calculation we can conclude that the installation cost for the solar energy is very high, but also we represent that after 30 months we will achieve our payback. After the 30 months we will gain rupees 10,070 per month.

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